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AIR POWER AND THE DEFEAT OF A WARSAW PACT OFFENSIVE

Taking a Different Approach to Air Interdiction in NATO

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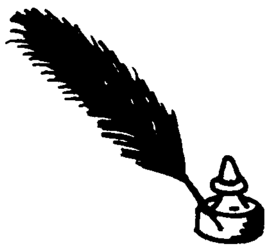

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AIR POWER AND THE DEFEAT OF A WARSAW PACT OFFENSIVE
Taking a Different Approach to Air Interdiction in NATO

by

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ABSTRACT

The current US Air Force approach to air interdiction in the North Atlantic Treaty Organization (NATO) is primarily attrition-oriented. This approach is flawed because of its requirement to attack Warsaw Pact strengths, rather than exploit its weaknesses. This error is compounded by a tendency to underestimate the inherent weaknesses of this approach. An examination of history and Soviet doctrine and strategy indicates that air interdiction in NATO would be more effective if the US Air Force used the tremendous potential of the family of air scatterable mines (FASCM) to delay and disrupt a Warsaw Pact offensive. The use of FASCM would allow NATO to attack directly weaknesses in Soviet doctrine and strategy. Intelligently integrated with the maneuver of NATO land forces, air interdiction using FASCM could create powerful synergies. Despite these potential advantages, there are several problems that must be overcome before the US Air Force could make effective use of FASCM in a NATO air interdiction campaign. The easiest problem to solve is the development and procurement of suitable FASCM. More difficult problems are the shortage of personnel qualified to plan and control such an air interdiction campaign and the lack of suitable air interdiction doctrine.

AIR POWER AND THE DEFEAT OF A WARSAW PACT OFFENSIVE
Taking a Different Approach to Air Interdiction in NATO

To have the best opportunity of defeating a Warsaw Pact offensive, the United States Air Force should approach air interdiction in NATO from a different perspective. This new approach should emphasize creating delay and disruption and taking advantage of the tremendous potential of the family of air scatterable mines (FASCM). Such a change is necessary because our present approach is primarily attrition-oriented and attacks Warsaw Pact strengths, particularly its quantitative superiority, rather than its weaknesses. We have further compounded our error by underestimating the handicaps facing our current air interdiction plan. To understand why an approach emphasizing delay and disruption instead of attrition as an objective would be more effective, our first step should be to examine the weaknesses of our present approach. Next, we must examine the reasons why two World War II air interdiction campaigns proved especially successful. By taking these steps, we can see why a different air interdiction approach in NATO is necessary and also what this approach should be.

The Present Air Interdiction Approach

The attrition orientation of our current interdiction approach is particularly evident in the Department of Defense's adoption of the armored division equivalent (ADE) as a basic unit of comparison of relative ground force effectiveness. The Defense Department uses the ADE in the Attrition-FEBA (forward edge of the battle area) Expansion model to assess the contribution of NATO air interdiction. To do this the estimated number of air interdiction armored vehicle kills are converted into an ADE score, which is added to the attrition inflicted by NATO ground forces. This produces the projected Warsaw Pact daily loss rate. This loss rate is compared to NATO's projected losses to determine relative success.[1] An admitted problem with this model is its inability to deal with "fluid warfare that would probably characterize a Warsaw Pact attack after only a few days of mobilization . . . in other words, a surprise attack."[2]

In addition, as Maj Gen Jasper Welch, Jr., US Air Force (Ret), notes, programs supported by the Office of the Secretary of Defense suffer by being tied ". . . far too closely to the presumption that only one class of targets is important (tanks), located only in one place (as far to the enemy's rear as feasible), and to be attacked as early as possible." He states the Army and Air Force have made a different choice, to attack Warsaw Pact maneuver forces nearer the front lines using direct attack munitions like the imaging infrared (IIR) Maverick.[3]

The current Air Force position on air interdiction is explained by Lt Gen Merrill A. McPeak, US Air Force. He notes that in the period "up to the mid-70s, the main emphasis was on 'isolating' the battlefield, reducing the flow of men and materials by attacking the lines of communications (LOC) infrastructure."[4] Now, he says, we view the battlefield in great depth, featuring an arrangement of enemy forces in a succession of echelons and we must attack the second echelon target set. Therefore, much more attention is now given "to attacking enemy main force units as they move to contact. This changing emphasis can be seen in our doctrinal treatment of the interdiction mission. We are now giving much more attention to 'battlefield air interdiction' (BAI)." He continues that, with BAI targets, immediate effects are desired so we "must attack BAI targets directly with the purpose of destroying them."[5] As these targets "move and move around-the-clock, we need systems like LANTIRN [low-altitude navigation and targeting infrared system for night] and IIR Maverick."[6]

Weaknesses of the Present Approach

Although the Air Force approach differs from those that emphasize attacks far in the rear, it is alike in its focus on destruction. This tendency is explained by Benjamin S. Lambeth, a senior staff member of the Rand Corporation, who notes that assessments in Air Force planning too often "look solely to the technical aspects and size of the enemy's forces, without much thought given to considerations of context or to those important intangibles relating to the enemy's operational skill that will govern how, and with what effect, his technical effects might perform in combat."[7] One of four errors in Air Force planning that Lambeth identifies is confusing enemy force size with strength. He writes that "this fixation on force size as the most important ingredient of enemy capability is a classic case of bookkeeping masquerading as analysis." The result, he contends, is development of the mistaken impression that "war is merely a firepower equation writ large and that favorable asymmetries in the numbers balance can be automatically traded for battlefield gains."[8]

Surveillance

Besides making air interdiction plans that focus on Warsaw Pact strengths, we tend to underestimate the handicaps facing this approach, particularly the problem of locating mobile Warsaw Pact forces. The first requirement for successful interdiction when using direct attack munitions like Mavericks and nondelay fuzed, general-purpose bombs is reliable, timely target information. Yet, as Gen Johannes Steinhoff, retired Luftwaffe inspector general, recently stated, "NATO's reconnaissance beyond line of sight is scandalous."[9] Joint surveillance and target attack radar system (J-STARS) is seen as one method of improving NATO reconnaissance capabilities.[10]

However, possessing timely and reliable information on the location of mobile targets is only one of several requirements, all of which must be satisfied if the current, direct attack approach to air interdiction is to be effective. Target location information not only must be very precise, it must also be available to the aircrew who is directly responsible for hitting the target with the munition. Merely knowing the approximate location of a mobile target is not sufficient to ensure an aircrew can accurately deliver direct attack air interdiction munitions. J-STARS is designed to be able to help provide aircrews this precise information. However, until such a capability is available, aircrews still must autonomously acquire the target and then maneuver, if necessary, to ensure accurate weapons delivery.

Target Acquisition

As Warsaw Pact forces may choose to move at night or in bad weather, NATO air interdiction effectiveness depends on the ability of attacking aircrews to acquire targets in these conditions. Low-altitude navigation and targeting infrared system for night is designed to overcome the visibility restrictions caused by darkness and haze. However, regarding true night, under the weather capability, until LANTIRN becomes available we have, in the words of the late commander of

Tactical Air Command, Gen Jerome F. O'Malley, "virtually no capability against small or mobile targets."[11]

Besides these restrictions, uneven terrain and vegetation, which are prevalent in NATO, also act to degrade target acquisition, particularly from the low altitudes flown to evade Warsaw Pact ground air defenses. To overcome these restrictions to visibility, aircrews often must fly a pop-up maneuver to gain the altitude they need for a less obstructed view of the target area. However, even when there is good information available on a target's general location and an aircrew is able to navigate accurately to the target area and properly identify the pop-up point, acquisition of uncamouflaged targets such as vehicles remains a difficult problem.

An appreciation of the problems involved in finding a target the size of a tank can be gained from a look at the experiences of one highly experienced "tank killer." During World War II, Luftwaffe Col Hans Rudel was credited with at least 519 Soviet tank kills. He flew more than 2,500 sorties, most in a Ju-87 cruising at 250 km/hr and an altitude of 1,500 meters, weather permitting. According to Colonel Rudel "the problem was not actually shooting or killing the tank, but it was <u>finding the tank</u>."[12] (Emphasis in the original.)

<u>Target Identification</u>

After a vehicle is acquired, there is still a requirement to identify it if it is desired not to expose aircraft and waste antiarmor munitions in attacks on trucks. Unfortunately, in the past this task proved to be quite difficult as can be seen in Colonel Lallemant's experiences as a 609 Squadron, Royal Air Force Typhoon fighter-bomber pilot during World War II. Typhoons could carry eight 60-pound air-to-ground rockets, which were quite effective against tanks, along with four 20-mm cannons. Colonel Lallemant, a Belgian and a very successful tank killer, preferred not to waste his rockets on trucks. Therefore, as German vehicles often were either camouflaged or parked under trees, his practice was to make a pass at low level before firing to pick out the tanks from soft-skinned vehicles. Although this identification method was reliable, it was also extremely dangerous and Colonel Lallemant's commander did not approve.[13]

Today's requirement to identify a target is caused by the relationship between the same two factors: the nature of the threat and antiarmor munitions characteristics. Despite perceptions to the contrary, the vast majority of Warsaw Pact vehicles in the "target-rich" environment behind the front are not tanks.[14] Also, unlike Allied experience in World War II, due to Warsaw Pact emphasis on surprise and rapid movement, NATO may have only a limited period of time for air interdiction to kill enough tanks to influence the battle.[15] Therefore, unless there is some way for reliably identifying which vehicles are tanks, NATO may be required to kill vast numbers of Warsaw Pact vehicles in a short period of time.

The other related factor, which contributes to the need to determine whether a vehicle is a tank or not, results from the characteristics of antiarmor munitions. A tank is "harder" than any other vehicle found on the battlefield. As a result, a weapon that may be satisfactory for destroying a light armored vehicle like a BMP or a "soft" unarmored truck could easily have a low probability of harming a tank, let alone achieving a catastrophic kill. The problem is that developing a munition with the characteristics, such as accuracy and penetrating capability, which are needed to ensure a high probability of destroying a tank often results in four tradeoffs.

Antiarmor Munitions Tradeoffs

One tradeoff is that such an antiarmor capability usually makes a munition more expensive and, thus, available in fewer numbers.[16] As long as antiarmor capable munitions like Maverick are available in limited numbers, it becomes important not to "waste" many of these munitions against vehicles that are not tanks.

Beside cost, often there is a second tradeoff when special avionics modifications are necessary for an aircraft to employ antiarmor munitions. Most guided weapons require such modifications. Along with their initial expense, these modifications impose significant training and maintenance burdens.

Determining if a potential target is a tank and not another type of vehicle is one important objective of the LANTIRN target pod automatic target recognizer.[17] The automatic recognizer feature is particularly necessary because of the demanding nature of using LANTIRN to acquire targets while flying a high-performance aircraft close to the ground, at night, and under the weather. (With LANTIRN, the pilot can see only the area directly in front of the aircraft that is within the heads up display's field of view. As a result, he is approaching potential targets at a very high rate of closure--at 400 knots, a kilometer is covered in about five seconds. In less demanding daytime operations, most targets are acquired off to the side of the aircraft, thereby reducing rate of closure and increasing the time to perform an attack.)

Unfortunately, the automatic target recognizer feature of LANTIRN has experienced developmental difficulties and unit costs have grown from $3 million in 1981 to more than $5 million in 1984.[18]

A third tradeoff is that special maneuvers, like a pop-up, often are needed to deliver the munition. Guided munitions like the Maverick require aircrew acquisition of a target in time to obtain a successful lock-on. Ideally this lock-on is achieved at a distance great enough to allow the aircrew to avoid short-range "point" air defenses that are often located near the target. Yet, if this is possible it is likely this distance will prevent the aircrew from determining what type of vehicle they are attacking. If the aircrew waits to ensure positive vehicle identification, they will probably sacrifice any stand-off advantages and may be too close to deliver the Maverick safely. In this case, the maneuver needed to provide time for target acquisition and lock-on may result in the aircrew being more exposed to ground-based air defense threats than would be the case with other, less specialized munitions like a 30-mm cannon.

A fourth tradeoff may be low aircrew confidence in a munition. If aircrews perceive that it will be difficult to deliver a weapon successfully on the first pass or that weapons delivery requires high exposure to air defense threats, then they may have little confidence in the weapon. In combat, lack of confidence in one's weapons often contributes to low morale, and this in turn may mean the weapon will not be employed with the effectiveness desired or expected by planners.

Warsaw Pact Countermeasures

Still another major problem with the current approach to air interdiction in NATO results from the ability of the Warsaw Pact to develop effective countermeasures. Warsaw Pact electronic combat and direct attack capabilities could destroy or disrupt a key part of NATO's interdiction command and control system, particularly its intelligence gathering and communications facilities. For instance, if the opposition is able to destroy the J-STARS platform in its orbit or at its base, or disrupt its communications, this entire system is rendered ineffective. It is also possible that enemy forces will be able to deceive surveillance and acquisition systems such as J-STARS and LANTIRN. Currently the Soviets are devoting great efforts to camouflage, concealment, and deception, employing large numbers of radar reflectors and great amounts of smoke.[19]

Warsaw Pact air defenses pose still another potent countermeasure. With most current munitions NATO aircraft performing air interdiction not only must penetrate enemy area air defenses but also their point air defenses in order to attack advancing maneuver units. Avoiding these defenses is the main reason for an increasing emphasis on developing complex and expensive stand-off air-to-surface munitions. Gen Bernard W. Rogers, Supreme Allied Commander, Europe, believes Warsaw Pact air defenses are so effective that he advocates developing unmanned interdiction systems.[20]

The emphasis on surprise and speed found in Warsaw Pact doctrine presents still another potential countermeasure to an attrition approach to air interdiction. Experience in past wars shows that great amounts of time and resources are usually required for attrition to have a significant impact. Therefore, if a Warsaw Pact offensive is able to achieve the rapid advance called for in its doctrine, it seems unlikely that there will be sufficient time for NATO air interdiction to influence the battle. Further, there are serious questions as to whether technology will prove to be an adequate substitute for the vast resources required to achieve the high exchange ratio that is the goal of the current attrition-oriented air interdiction approach. Questionable assumptions, that are often not fully explored in testing, place the effectiveness of some high technology weapons in doubt. These assumptions include affordability, countermeasure effectiveness, training requirements, and maintainability.[21]

Air Interdiction in World War II

It is clear that the current approach to air interdiction has many limitations that have not been overcome or, perhaps, even recognized. Given the questions this raises about the viability of the present approach, it is worthwhile to review the prevailing conditions and what worked in two of history's most effective air interdiction campaigns. During World War II, both in Italy during Operation Strangle (15 March to 11 May 1944) and in Normandy, the Allies had the initiative, air superiority, time, and vast air resources. The initial objective in Italy was to reduce the flow of supplies to the point where German forces could no longer fight in central Italy.[22] During the campaign, 34,000 Allied sorties delivered 33,000 tons of munitions, yet sufficient supplies were able to get through for German resistance to continue.[23] The break came when Operation Diadem (the combined ground-air offensive) was launched. The speed and intensity of the Allied ground offensive, combined with the disruption of German tactical mobility by air interdiction, made it impossible for German ground combat units to contain the Allied ground offensive. Therefore, to understand the real contribution of air interdiction to this campaign, static measures of destruction are not sufficient. Instead, one must recognize the synergistic effects resulting from the interaction of dynamic events, specifically the ability of air interdiction to affect the relative mobility of land forces.[24]

The Normandy campaign is similar to Strangle. The major air interdiction contribution was the impact on enemy mobility.[25] As a result of the massive dislocation and disruption of the German ability to move, the Allies were able to build up forces more rapidly, eventually defeating the Germans.[26] On 10 June 1944, the German commander, Field Marshal Erwin Rommel, commented that "movement of our troops on the battlefield is completely paralyzed while the enemy can maneuver freely."[27]

Looking closely at Normandy, one finds that the Allies' air interdiction effort was effective at disrupting mobility due to the almost continuous daylight presence of Allied air power in the form of roving fighter-bombers. This presence was noted by Rommel when he remarked:

> Every traffic defile in the rear areas is under continual attack, and it is very difficult to get essential supplies of ammunition and petrol up to the troops. Even the movement of minor formations on the battlefield--artillery going into position, tanks forming up, etc., is instantly attacked from the air with devastating effect. During the day, fighting troops and headquarters alike are forced to seek cover in

> wooded and close country in order to escape the continual pounding from the air.[28]

The Allied air presence was so overwhelming that on one day Rommel estimated 27,000 Allied sorties were flown. In fact, the unprecedented Allied effort on D-Day involved only 10,585 sorties flown by tactical and strategic air forces.[29]

Yet, these sorties Rommel observed did not, in fact, destroy vast numbers of vehicles. For instance, out of the 40,000 to 45,000 vehicles and 800 tanks involved in the German escape from the Falaise pocket, only 9 percent of the vehicles and 2 percent of the tanks were lost due to air attack. Another 6,000 to 8,000 vehicles were abandoned because they had no fuel.[30]

Advantages of a Different Approach

Is it likely that NATO air interdiction will realize its full potential as long as its main objective is attrition? If not, a different approach is needed, one that focuses on Soviet weaknesses. Similarly, this approach must employ NATO strengths and avoid known weaknesses. Therefore, if the past is any guide, NATO's air interdiction objectives should be delay and disruption rather than destruction. (This does not mean that destruction is not intended, but only that it is used as a <u>method</u> for achieving the <u>objective</u>.) Furthermore, causing delay and disruption can be useful only if these effects are designed to complement NATO land maneuver. NATO air interdiction must deny Warsaw Pact forces the ability to move rapidly relative to the maneuver of NATO land forces. It also must successfully handicap the ability of Warsaw Pact tactical commanders to integrate their combined arms capabilities.

In order for this approach to be effective, four major requirements must be met. First, air interdiction must be able to slow the movement and destroy enough vehicles in key areas so that pact forces will be unable to achieve either the concentrations of cohesive units needed to penetrate NATO ground defenses or that these units will not have the speed needed to exploit any breakthrough that does occur. Second, this effect must be achieved in a short period of time, despite restrictions to target acquisition capabilities caused by weather, darkness, vegetation, and terrain. Third, it must be done despite Warsaw Pact countermeasures. Finally, NATO must be able to do all this without many of the advantages the Allies possessed in World War II.

Simultaneously meeting these requirements, while employing only current and programmed attrition-oriented systems, is unlikely for the reasons already addressed. Fortunately, the growing potential of the family of air scatterable mines provides NATO air forces with an opportunity to overcome current air interdiction handicaps. The reason for this is that employing air scatterable mines, in <u>combination</u> with current and programmed attrition-oriented capabilities, makes it possible to create a powerful synergy between NATO air and ground forces. The result of this synergy is that the relative maneuver capabilities of NATO ground forces would be so superior to those of the invading Warsaw Pact that an effective NATO defense would be far more probable. Reviewing the advantages of FASCM employment shows why such a synergy is possible.

Political Suitability

One advantage of using air scatterable mines results from the unique political conditions existing in NATO. Political requirements force NATO to be prepared to defend against a surprise attack at the political border but without the assistance of previously constructed obstacles and elaborate fortifications. If NATO air forces possessed a powerful FASCM capability, they could quickly erect minefields along Warsaw Pact routes of advance, while simultaneously destroying key bridges and other line of communications infrastructure. Thus, they would have the ability to create obstacles quickly, giving NATO land forces more time to deploy and create powerful defensive positions.

Threat to Soviet Doctrine and Strategy

Perhaps the most important advantage resulting from FASCM employment is its ability to create uncertainties and problems for Soviet military leaders by attacking weaknesses in Soviet doctrine and military strategy. The Soviet military is well aware of this threat posed by air scatterable mines.[31] In fact, a number of the West's Soviet experts have all noted the great concern with which Soviet military leadership views NATO's air scatterable mines capability.[32]

A possible reason for this concern is the ability of FASCM to take advantage of the poor quality of Soviet military leadership at the tactical level.[33] The inability of the Soviets to develop the necessary degree of initiative at this level makes it likely that their tactical commanders would not be able to adapt rapidly to changing conditions caused by the presence of mines. As it is difficult to determine the size, shape, or density of an air scattered minefield, tactical commanders would have to be able to exhibit a high level of judgment, deciding whether they can afford the losses inflicted by moving rapidly and not taking the time to clear mines. To be successful in such an environment, these commanders would have to know how both lost time and high casualties will affect their ability to accomplish the mission.

The rigidity of Soviet officers at the tactical level also makes it likely that FASCM would be very effective at disrupting their ability to integrate effectively different combined arms capabilities. For example, the presence (or suspected presence) of air scattered mines could delay deployment of air defense units into positions where they can protect the organization's movement, while simultaneously inflicting serious losses on these air defenses units. Similarly, the need for artillery to move quickly to avoid counter-battery fire would be seriously impeded by mines, making it more difficult for artillery to support the advance of infantry and tanks. By either delaying or destroying supply vehicles, the presence of FASCM could have an immense impact on the timely availability of the vast quantities of fuel and ammunition that are needed to maintain the desired rate of advance. Further, upon encountering areas infested with FASCM, dismounted infantry might be reluctant to move fast enough to stay with and support the forward movement of tanks. Soviet tactical commanders are likely to be reluctant to inform operational level commanders of these problems. As a result, decisions at the operational level, such as which axis of advance to support, could easily be based on increasingly erroneous information.[34]

Air scatterable mines can also take advantage of the requirement for Soviet operational level commanders to anticipate future support requirements. This is possible because FASCM obstacles can be deployed after operational level commanders commit forces to a particular route, making engineer reconnaissance reports seriously misleading.[35] Then, if an operational level commander determines that the presence of mines on a particular route is creating unacceptable disruption and delay, he would probably choose another route. As soon as NATO commanders detect such a shift, they could saturate the new route with mines. If a Soviet commander attempted to change routes very often, immense confusion could result as units and supplies become intermixed.

A Soviet offensive depending on speed is particularly vulnerable to such delay and disruption because of the criticality of timely fuel delivery to forward tactical units.[36] Employment of mines takes similar advantage of the Soviet repair doctrine. As tactical units possess comparatively little organic repair capability, even relatively minor damage inflicted by mines could quickly eliminate many vehicles.[37] At the same time, if a large number of vehicles required repair, vehicle recovery and repair organizations would be quickly overloaded.

Synergies with NATO Armies

A third advantage of using FASCM in air interdiction is the synergies that would be created with NATO land maneuver forces.[38] Unfortunately, too often the US weapons acquisition process tends to neglect or even ignore how the capability of one weapon affects the capability or effectiveness of another weapon. This tendency is particularly evident with respect to the weapons employed by the various armed services. To be comprehensive, a weapons acquisition and employment process for air interdiction must assess how an air interdiction munition which delays and disrupts the movement of various "soft" elements of the Soviet combined arms team and its support contributes to the effective employment of friendly land forces.[39] If such an assessment was made, we would be able to see the tremendous synergies that are created when air interdiction and friendly ground maneuver are intelligently integrated.

It is very likely that an ideal objective of NATO air interdiction using FASCM would be to strip away "soft" forces necessary to support Warsaw Pact armor.[40] By doing this, NATO air power would so enhance the effectiveness of NATO land forces' organic antiarmor capabilities that the overall contribution to NATO strategy would be much greater than if air interdiction had attempted to destroy a large portion of enemy armor. In addition, the delay imposed by air interdiction employing FASCM would make NATO intelligence information regarding the location of a Warsaw Pact unit less perishable. This would increase the likelihood that aircraft using direct attack munitions like Rockeye and Maverick would find concentrations of enemy land forces. Further, an enemy troop commander might be reluctant to disperse his forces off the road when under such air attack if he feared the presence of FASCM. Also, the mining of potential air defense positions should act to reduce the air defense threat facing these attacking aircraft. By slowing the movement and, therefore, degrading the employment of Warsaw Pact artillery, FASCM would enhance NATO counter-battery fire and the effectiveness of NATO infantry employing antitank weapons. Finally, by slowing the speed at which Warsaw Pact units move and the effectiveness of their resupply efforts, air scatterable mines would make it more likely that NATO ground forces would possess greater mobility and firepower enabling them to achieve the superiority needed to defeat Warsaw Pact units.

Deception Opportunities

A fourth advantage of a mine-oriented approach to air interdiction is that, unlike direct attack, immediate effect munitions, FASCM provides a significant opportunity for NATO to employ deception while simultaneously countering Warsaw Pact deception. By simulating the deployment of FASCM, NATO could make enemy commanders less certain about the location or extent of minefields. Further, the employment of a wide variety of mines with different sensors and fuzes would make it extremely difficult for the enemy to develop effective and reliable mine detection and clearing methods.[41] The nature of FASCM (the enemy comes to the mine) also renders ineffective those measures, such as camouflage, smoke, and radar reflectors, which are designed to prevent the aircrew target acquisition needed to employ direct attack munitions.

Decreased Surveillance and Target Acquisition Requirements

A fifth advantage resulting from FASCM employment is that it does not depend on complex, technically risky, often expensive, and perhaps, easily countered surveillance and target acquisition systems. Because they only attack movement, mines eliminate the direct attack munitions' requirement to determine if a vehicle was previously "killed."[42] The delayed nature of FASCM also means that delivery aircraft would not need sophisticated target acquisition capabilities that are necessary for the delivery of some direct attack munitions, particularly during darkness and in bad weather. If FASCM were deployed ahead of an advancing enemy unit, such as an operational maneuver group, large capacity aircraft like the B-52 could avoid point air defenses, becoming more survivable, while also eliminating the need for acquisition capabilities necessary for employing stand-off, direct attack munitions. Another FASCM advantage is that it reduces dependence on elaborate, expensive, and vulnerable time-sensitive command and control systems that are essential for effective employment of direct attack munitions. Therefore, substituting an air scatterable mine capability for a portion of the expensive target acquisition capabilities and stand-off munitions now planned should result in a more effective air interdiction capability for the same or perhaps an even lower cost.

Psychological Potential

Still another important advantage of FASCM is its psychological influence. The lack of feedback on the actual threat posed by a suspected minefield tends to magnify an enemy's perception of the threat. This causes even a suspected minefield to be treated as a serious danger. Also, after the presence of one or more mines is confirmed, there is no assurance that other mines do not remain undetected. This uncertainty is apt to discourage an indecisive enemy. Finally, the inability to fight back against mines, as compared to more tangible threats like aircraft, removes an important opportunity to release stress. As a result, minefields cause a potentially debilitating buildup of tension.[43] These psychological influences may be especially effective against the noncombat troops found in the rear area, particularly as such units are largely minority-manned and receive no significant military training.[44] The importance of a munition's psychological effects is well recognized by the Soviets. When the

Soviets discuss the contribution of artillery, they point to the importance of psychological aspects, noting that the effectiveness of artillery does not depend on destruction.[45]

Problems Implementing a Different Approach

Despite the many powerful reasons for an air interdiction approach designed to create delay and disruption by using mines as one of the principal munitions, there are three major reasons that prevent this approach from being rapidly and effectively implemented. For one thing, there are few air scatterable mine munitions in the current Air Force inventory or in development, and most of these do not have appropriate characteristics. A review of mine detection and clearing countermeasures is useful for showing what characteristics are desired. The second problem is the lack of personnel charged with planning and controlling an air interdiction campaign who are familiar with maneuver warfare and the potential contribution of FASCM. This introduces a third problem, the inadequacy of Air Force doctrine for waging an air interdiction campaign, particularly one using mines.

Availability of Suitable FASCM

The Air Force has only just begun procuring a single air interdiction FASCM system, Gator, with each weapon containing 72 antiarmor and 22 antipersonnel scatterable mines.[46] However, in order for a FASCM approach to air interdiction to be effective, a variety of scatterable mines have to be available in NATO and in large numbers. These mines must be compatible with delivery by most, if not all, aircraft that perform air interdiction, especially long-range, high-payload aircraft like the B-52. In addition, the design of these mines must take advantage of the many new developments that can make FASCM not only more effective against vehicles and personnel but also more difficult to detect or clear quickly.

In order to appreciate the potential capabilities of FASCM employing the characteristics of new generation mines, it is useful to compare them to old generation mines. Old generation mines usually are triggered by pressure and often employ large amounts of metal in their construction. Thanks to developments in electronics and materials, a new generation of mines is now available. These mines are much more lethal, efficient, and flexible. For example, the development of influence fuzes makes it possible for mines to respond to changes in magnetic field, vibration, noise, and even interruptions in infrared radiation. These fuze enhancements enable mines to attack targets that have not approached close enough to apply pressure. This capability, in turn, makes it possible for fewer mines to cover a given area; and fewer mines means a minefield can be emplaced faster and with less resources.[47] Fuze developments also are making mines much more lethal because they allow a mine to attack a vehicle where it is most vulnerable. An example is the full width mine, like Gator, that uses a shaped charge to attack the belly of a tank, achieving a high probability of a catastrophic kill. In contrast, pressure activated mines, which attack a tank's running gear, generally only cause minor damage that can be quickly repaired. During the Yom Kippur War, 75 percent of the tanks hitting pressure mines were operational within 24 hours. Besides totally destroying a tank, a full width mine will probably kill the crew as well. Watching another crew die can have an immense psychological effect on surviving crews.[48]

Technological developments allow other important capabilities. Fuzes can be designed to discriminate between types of vehicles and even determine in what direction a vehicle is moving. Self or remote activation and deactivation, as well as self-destruction or self-disarming after a predetermined period of time, also are possible. Employment of self-forging projectile charges enable new generation mines to be lethal to vehicles, even armored vehicles, from a greater distance than old generation high explosive mines.

Mine Detection and Clearing Countermeasures

A review of various countermeasures to mine detection and clearing capabilities helps illustrate the significant impact new generation mine developments are having on the role of mines in warfare. Other than activation of a mine, only three methods of mine detection generally are available. Metal detection is, perhaps, the most important method; however, the increasing use of nonmetallic materials in new generation mines and the large amounts of metal on the battlefield greatly handicap this method's effectiveness. Visual scanning is another important method of mine detection. This method can be degraded by darkness, smoke, vegetation, rapid movement, and uneven terrain. In addition, developments that increase a mine's range act to reduce significantly the effectiveness of visual detection. Probing is the third method, but because it is so slow, probing usually is done only after the presence of mines is known, and this is generally after a mine has exploded.

Other than accepting the probable loss of the lead vehicle(s) or personnel when moving through a minefield, methods for clearing mines are limited to the use of plows, rollers, flails, explosives, and removal by hand. Not clearing mines, but just continuing to move or "bull" through is very costly, particularly against the more lethal new generation mines like the full width mine. Even against old generation mines, this and the other clearing methods have severe limitations. All methods, except bulling through, are slow with plows, rollers, and flails being handicapped by uneven or hard ground and vegetation that can cause mines to be missed. Plows and rollers also limit vehicle maneuverability and introduce added wear on vehicles pushing them. Plows, rollers, and flails only clear narrow channels.[49] As rollers and flails rely on contact to apply pressure, they are damaged by mine explosions and soon can be rendered totally ineffective. In fact, a roller often will crack or shatter after several mine encounters. If a mine has a double impulse fuze, it will allow a roller to pass harmlessly, enabling the mine to be detonated by the vehicle pushing the roller. Pressure release and other antihandling devices will destroy plows, as well as discourage removal by hand.[50] Explosive cords or fuel-air explosives are proving to be a more effective method of clearing mines, but this method is slow, not always easy to deploy, and may miss mines that are insensitive to shock or pressure.

Except for the bull through method, all mine-clearing techniques require specialized engineer equipment and trained personnel. These resources often are not readily available behind the lead units of the front echelon of an offensive. What is even more important, all these methods are oriented toward clearing old generation, metal, pressure-activated mines, and only those mines directly on an intended path, not those standing off to the side. It is also worth pointing out that, in addition to the problems already identified, mine clearance can be made much more difficult when a minefield consists of different types of mines. Finally, as was demonstrated in Vietnam, secretly sowing mines in previously cleared areas has proved to be an effective method of defeating mine clearance operations.

The difficulties involved in detecting and clearing new generation mines became apparent in the recent war in the Falklands. The Argentine military employed both the Italian Valsella VS-1-6 scatter-drop antitank mine and MISAR SB-33 antipersonnel mine. Both types proved "most difficult to detect for their streamline shape and corrugated plastic bodies enabled them to 'blend' quickly with the soil in which they were hidden. Even under controlled training conditions they remain very difficult to detect." Clearing area-denial BL-755 minelets from airfield runways in the Falklands also proved to be problem.[51]

Recognizing their growing potential, most Western militaries have developed a variety of FASCM. To prevent rapid clearance of antiarmor barmines, the British army employs the Ranger antipersonnel FASCM.[52] The British Royal Air Force uses FASCM in the JP-233 low-level airfield attack weapon system.[53] The German army possesses the new generation AT-2 antitank FASCM, 600 of which can be scattered by the MiWS mine launching system.[54] The German air force has three new generation FASCM, all of which are carried in the Tornado aircraft's MW-1 multipurpose weapon system.[55] The US Army uses the UH-1 helicopter and artillery to deliver two new generation FASCM, the area denial artillery munition (ADAM) and remote antiarmor mine (RAAM).[56] With the Volcano mine-delivery system now under development, the Army will possess the ability to deliver FASCM from the UH-60A.[57] The Soviet military also possesses antipersonnel and antiarmor FASCM. These FASCM can be employed by BM-27 multiple rocket launchers, Mi-8 Hip helicopters, and fixed-wing aircraft. In the Afghanistan war, the Soviet PFM-1 "Butterfly" FASCM is proving to be one of their most effective weapons.[58]

Unfortunately, there is a problem handicapping employment of FASCM like Gator in air interdiction. They are relatively easy to detect on the smooth surfaces of major roads. However, this may not be a major problem if the plan for a Soviet offensive attempts to increase the opportunity for achieving surprise by moving forces at night or during poor weather and uses secondary roads.[59] Also, the damage to these routes caused by earlier air attacks and the heavy traffic of wheeled and tracked vehicles would soon make most road surfaces rough enough to make even Gator's mines relatively difficult to detect.

Still, in order to make FASCM more difficult to detect and clear, it is desirable to increase the effective range of a mine. One way to do this would be to develop a mine with the weapons effect characteristics of the antimateriel incendiary submunitions (AMIS) and the sensor and fuze capabilities of the now canceled extended range antiarmor munitions (ERAM).[60] Not only would such a mine be very difficult to detect and clear because of its great range, it would also be extremely effective against most Soviet vehicles. Too often, attempts to make FASCM effective against tanks result in an expensive munition whose effects are too concentrated for it to be a good air interdiction munition. Although AMIS type effects may not be very good for reliably causing catastrophic tank kills, as noted earlier most vehicles in the rear area are not tanks. Even so, a mine with AMIS effects could still have a high probability of causing significant damage to a tank's optics, radios, and externally stored fuel. Also, as tank crews generally do not button up during rear area movement, exposed crew members would stand a high probability of being killed or wounded.

Shortage of Qualified Personnel

Besides the current lack of suitable air scatterable mines, another handicap to the proposed approach is that most of the personnel responsible for planning and controlling an air interdiction campaign do not have the necessary knowledge. Compared to an attrition-oriented approach, using air interdiction to complement land maneuver, when both time and resources are limited, requires in-depth knowledge of the art of war at the operational level, including familiarity with the capabilities and limitations of both air power and land warfare. Unfortunately, many Air Force personnel filling positions in the tactical air control system (TACS) have little knowledge of the complexities of land warfare and are especially innocent of experience at the operational level of war as articulated in either Soviet or US Army doctrine.[61] Too often, Air Force officers reaching command and staff positions involved with planning and controlling an air interdiction campaign have devoted their careers to the tactical level of war, either flying aircraft or supervising sortie generation. Only when they are assigned to TACS positions do they receive training above the tactical level and this is generally limited to procedures.[62] This lack of familiarity with warfare above the tactical level is not a problem unique to the Air Force. Army leadership, despite changes in Army doctrine, is also inexperienced at the operational level.[63] As a result, neither Air Force nor Army officers understand the operational level of war well enough to assure that land maneuver and air interdiction employing FASCM will be integrated in a way that creates powerful synergies.

Inadequate Air Interdiction Doctrine

The third problem is closely related to the second. Published Air Force doctrine on the actual waging of an interdiction campaign is shallow at best. Only very general air interdiction objectives are provided in any Air Force doctrine publications and none discusses in any depth the capabilities and limitations of air interdiction, as experienced in past air interdiction campaigns.[64] Similarly, Army AirLand Battle doctrine, despite its title, makes only superficial mention of how air power, and particularly air interdiction, can contribute to combat effectiveness.[65] In order to correct these deficiencies, both Air Force and Army doctrines should explain how air interdiction and land maneuver should be integrated in order to create the powerful synergies that can lead to theater success. Such a treatment would go far beyond the procedurally oriented guidance currently found in joint attack of the second echelon (J-SAK) and joint operational concept and procedures for coordination of employment of air delivered mines (J-MINES). It would not ignore Soviet doctrine; instead, it would focus on how to create and exploit Soviet weaknesses, while not ignoring our own limitations and vulnerabilities. Besides the capabilities and limitations of delivery vehicles and munitions, such a treatment would address joint command and control, particularly how frictions, uncertainties, and time influence air interdiction's ability to contribute to success in maneuver warfare.[66] By explaining why speed, surprise, and deception are so important in maneuver warfare, this treatment would show how area denial munitions can make a significant contribution to air interdiction.

Developing a Different Approach

It is clear that a different approach to air interdiction in NATO is needed. This approach should be developed by applying insights from past air interdiction successes and failures to knowledge of current capabilities and limitations of NATO and Warsaw Pact air and land forces. Such an approach would require giving greater attention to how and why delay and disruption created by air interdiction complements friendly land maneuver. Recognition of the importance of delay and disruption would also make the air interdiction potential of FASCM more apparent.

To develop this new approach, the Air Force and Army must work together more closely, perhaps through the Joint Force Development process. Their objective would be to ensure that Air Force air interdiction doctrine is effectively integrated with Army land maneuver doctrine. As part of this process, they would identify what FASCM characteristics are most desired for air interdiction, as well as approximate quantities that are necessary to achieve the desired results.

Ultimately, the success of any new approach depends on how well (if not, indeed, whether) the proposed changes can be (1) adapted to existing equipment and ways of thinking, and (2) institutionalized through service education.[67] There are some who feel that "the bedrock error in traditional US air doctrine [is] the assumption that war's essential processes can be precisely and exhaustively determined."[68] I agree that there is such a tendency and believe that education can show why the present approach to air interdiction contains serious weaknesses because of this inclination. To do so, service education must begin by examining the nature of war and the parts played in it by uncertainty, chance, and unpredictability.[69] Once officers discover that war is at least as much an organic phenomenon as it is a mechanistic one,[70] they will have no difficulty recognizing why the proposed approach makes far more effective use of newly emerging technologies to enhance NATO deterrence.

NOTES

1. Barry R. Posen, "Measuring the European Conventional Balance," International Security, Winter 1984-85, 58-59.

2. Ibid., 60.

3. Maj Gen Jasper Welch, Jr., US Air Force (Ret), "DOD's Interdiction Program: The End of the Beginning," Armed Forces Journal International, May 1981, 118.

4. Lt Gen Merrill A. McPeak, US Air Force, "TACAIR Missions and the Fire Support Coordination Line," Air University Review, September-October 1985, 69.

5. Ibid., 70.

6. Ibid., 72.

7. Benjamin S. Lambeth, "Pitfalls in Force Planning: Structuring America's Tactical Air Arm," International Security, Fall 1985, 91.

8. Ibid., 92.

9. Benjamin F. Schemmer, "Pave Mover-J/STARS," Armed Forces Journal International, January 1983, 47.

10. Ibid., 39. The Defense Advanced Research Projects Agency has demonstrated the J-STARS concept with the Pave Mover radar. Pave Mover proved it could locate and track moving targets the size of a tank at ranges greater than 150 kilometers.

11. Judy Jaicks McCoy and Benjamin F. Schemmer, "An Exclusive AFJ Interview with Gen Jerome F. O'Malley," Armed Forces Journal International, January 1985, 76.

12. Transcript of Antitank Warfare Seminar, 14-15 October 1976, Washington, D.C., 14.

13. Christopher Shores, Ground Attack Aircraft of World War II (London: Macdonald and Jane's, 1977), 155-57.

14. Daniel Goure and Jeffrey R. Cooper, "Conventional Deep Strike: A Critical Look," Comparative Strategy 4, no. 3, 228; C. J. Dick, "Soviet Doctrine, Equipment Design and Organization," International Defense Review, December 1983, 1718. A single Soviet tank division alone possesses some 3,000 vehicles, only 331 of which are tanks. In addition to division vehicles, Army and Front support functions also introduce into the same area thousands of vehicles that are not tanks.

15. Dick, 1715.

16. Benjamin F. Schemmer, "Does the US Now Have the World's Worst Weapon System Acquisition Process?" Armed Forces Journal International, September 1984, 93. Antiarmor munitions like the Maverick, early models of which cost about $17,000 each, were produced in relatively small number (about 1[illegible] AGM-65Bs since 1975), when compared to less antiarmor capable munitions. The more capable imaging infrared (IIR) Maverick (AGM-65D) is even more expensive.

17. Clarence A. Robinson, Jr., "Board Asks Caution in LANTIRN Upgrading," Aviation Week and Space Technology, 26 September 1983, 32.

18. "Martin Marietta to Produce LANTIRN Pods," Air Force Times, 22 April 1985, 43; McCoy and Schemmer, Interview, 73.

19. Cmdrs J. Ellsen and J. Jarnekull, "To See, But Not to Be Seen," Armada International, March 1982, 64-73. Recent developments in camouflage and aerosols have demonstrated the ability to defeat acquisition by radar, infrared, and even false color television designed to contrast chlorophyll from nonchlorophyll colors.

20. "FOFA: Myth or Reality? Interview with Gen Bernard W. Rogers," Military Technology, March 1985, 29; Anthony H. Cordesman and Benjamin F. Schemmer, "An Exclusive AFJ Interview with Gen Bernard W. Rogers," Armed Forces Journal International, September 1983, 80.

21. See Stephen L. Canby, "The Conventional Defense of Europe: The Operational Limits of Emerging Technology," The Wilson Center, Working Paper, published in Current News Special Edition, 17 September 1985, no. 1346; Michael Handel, "Numbers Do Count: The Question of Quality versus Quantity," The Journal of Strategic Studies, September 1981, 225-60; and How Well Do the Military Services Perform Jointly in Combat? DOD's Joint Test-and-Evaluation Program Provides Few Credible Answers. Comptroller General Report to the Honorable David Pryor, United States Senate, GAO/PEMD-84-3, 22 February 1984, 52, 82. According to this GAO report, the plan for joint testing of the IIR Maverick had recommended testing employment against enemy ground force maneuver, camouflage, and deception in reaction to air attack. This was not done. Similarly, the report states the joint tactical aircraft effectiveness and survivability in the close air support antiarmor operations test did not allow actual use of smoke or fire for fear these restrictions to visibility would interfere with the quality of measurements.

22. The Uncertainty of Predicting Results of an Interdiction Campaign (Sabre Measures, Alpha, HQ USAF/Studies and Analysis, December 1969), 3.

23. Ibid., 7-16.

24. Ibid., 16-23; F. M. Sallagar, Operation "STRANGLE" (Italy, Spring 1944): A Case Study of Tactical Air Interdiction, Rand Report

R-851-PR (Santa Monica, Calif.: Rand Corporation, February 1972), 60-79.

25. Edmund Dews and Felix Kozackzka, *Air Interdiction: Lessons from Past Campaigns*, Rand Report N-1473-PA&E, (Santa Monica, Calif.: Rand Corporation, September 1981), particularly 6-9, and 12-14.

26. Ibid., 8; Eisenhower Foundation, ed., *D-Day: The Normandy Invasion in Retrospect* (Lawrence: University Press of Kansas, 1971), 63; B. H. Liddell Hart, *The German Generals Talk* (New York: Morrow, 1948), 243-44.

27. B. H. Liddell Hart, ed., The Rommel Papers, (New York: Harcourt, Brace and Company, 1953), 476.

28. Ibid., 476-77.

29. Ibid., 477.

30. Dews and Kozackzka, 12.

31. Christopher Bellamy, "Firepower Superiority," *Jane's Defence Weekly*, 12 January 1985, 65. In the Soviet Army newspaper, *Red Star*, Maj Gen I. Vorob'ev stressed the threat posed by remotely delivered mines to the insertion of an operational maneuver group.

32. Richard Simpkin, Red Armour (New York: Brassey's Defense Publishers, 1984), C. N. Donnelly, "The Soviet Operational Manoeuvre Group," *International Defense Review*, September 1984, 1186; John Erickson, "An Evaluation, Soviet Combined Arms Operations," *Armor*, May-June 1980, 16.

33. C. J. Dick, "Soviet Battle Drills, Vulnerability or Strength," *International Defense Review*, May 1985, 665.

34. John Hemsley, *Soviet Troop Control* (New York: Brassey's Publishers Limited, 1984), 145, 175, 177-78, 191-201; Arthur W.

McMaster III, "Ivan Has Training Problems," Armor, May-June 1982, 31-34.

35. C. N. Donnelly, "Combat Engineers of the Soviet Army," International Defense Review, February 1978, 196, 198-200.

36. Donnelly, "Tactical Problems Facing the Soviet Army," International Defense Review, September 1978, 1410, and "Rear Support for the Soviet Ground Forces," International Defense Review, September 1979, 344-50; John Erickson, "The Soviets: More Isn't Always Better," Military Logistics Forum, September-October 1984, 61.

37. Donnelly, "Rear Support for the Soviet Ground Forces," 345.

38. Gen Sir Martin Farndale, KCB, COMNORTHAG, "Counter Stroke: Future Requirements," RUSI, December 1985, 8. While he sees the need for scatterable mines, he neglects to mention aircraft as a means of delivery.

39. Joint Force Development Initiative 22, Joint Target Set, has an objective similar to the one proposed here, namely to establish an Army/Air Force consensus on the attack of enemy surface targets and develop a coordinated munitions plan. This initiative is one of 31 initiatives originally identified for attention by the Joint Force Development Process. The US Army and Air Force Chiefs of Staff signed a Memorandum of Agreement on 22 May 1984 establishing this process, the objective of which is fielding the most affordable and effective airland combat forces. Since then, more initiatives have been added and still others proposed for consideration as future initiatives. Target acquisition capabilities and countermeasures and air scatterable mine development and employment are two of the proposals suggested as potential future initiatives.

40. John Erickson, "An Evaluation, Soviet Combined Arms Operations," Armor, May-June 1980, 16-21; Malcolm Allen, "Combating NATO's Integrated Area Anti-Tank Defense," Jane's Defence Weekly, 20 July 1985, 139-42; and Donnelly, "Soviet Tactics for Overcoming NATO Anti-Tank Defense," International Defense Review, July 1979, 1099-1106. These authorities all noted that the Soviets recognize the vulnerability of unsupported armor to antitank defenses. The Soviet solution is the combined arms approach.

41. Norman L. Dodd, "Mines and Mine Clearance," Asian Defense Journal, December 1983, 74-76; Stefan Geisenheyner, "Land Mines for Offense and Defense," Asian Defense Journal, April 1983, 12-18; and Donnelly, "Tactical Problems Facing the Soviet Army," 1412.

42. In Southeast Asia it was not uncommon for several different sorties to attack and "destroy" the same vehicles. This was largely because these vehicles were "in the open," while functional vehicles were concealed. A knowledgeable forward air controller could prevent this because he could provide current intelligence. Providing such information in a European war would be extremely difficult.

43. William L. Greer and Cmdr James Bartholomew, US Navy, "The Psychology of Mine Warfare," Proceedings, February 1986, 58-62.

44. Maj J. Kazokins, Royal Army, "Nationality in the Soviet Army," RUSI, December 1985, 31.

45. Capt J. W. Kehoe, US Navy (Ret), and K. S. Brower, "US and Soviet Weapon System Design Practices," International Defense Review, June 1982, 740.

46. "Weapons Development Proceeds Amid Budget Holds, New Technology," Aviation Week and Space Technology, 2 December 1985, 152.

47. Lt Col Pierre Crevecoeur (C. R.), "Anti-Tank Mines of the Second Generation," Armada International, January 1984, 30.

48. Ibid., 26-28.

49. Plows only clear channels for the vehicle's tracks.

50. John F. Rybicki, "Land Mine Warfare and Conventional Deterrence," NATO's Sixteen Nations, September-October 1984, 77-78.

51. Terry J. Gander, "Land Mine Warfare--The British Position," Jane's Defence Weekly 4, no. 6 (1983): 597-607.

52. Ibid., 597-607.

53. Mark Hewish, "The JP 233 Low-Level Airfield Attack Weapon System," International Defense Review, April 1984, 485-87 and Norman L. Dodd, "Mines and Mine Clearance," 74-75.

54. Wolfgang Schneider, "The Bundeswehr's Combat Engineers," International Defense Review, April 1985, 535. Wolfgang Flume and Enrico Po, "MLRS: An Artillery Rocket System for NATO," Military Technology, January 1985, 21.

55. Wolfgang Flume, "MW-1-The Multi-Purpose Weapon System," Military Technology, February 1985, 66-70.

56. John Rybicki, "A Formula for Defense," Military Technology, March 1984, 97; Konrad Alder, "Modern Land Mine Warfare," Armada International, June 1980, 13.

57. "Volcano Mine-Delivery System," International Defense Review, March 1984, 340; Rybicki, "Land Mine Warfare," 78, 79.

58. Lt Col William P. Baxter, US Army (Ret), "Soviet Mine Warfare: Army's Silent Death," Army, July 1982, 43; "International Defense Digest," International Defense Review, January 1981, 19; "PFM-1 Mine in Afghanistan," Jane's Defence Weekly, 23 February 1985, 320; "PGMDM

Anti-Tank Mine," Jane's Defence Weekly, 11 January 1986, 19. Given the nature of the war in Afghanistan, the principal Soviet FASCM effort seen there so far has had an antipersonnel orientation.

59. The German attacks through the Ardennes in World War II demonstrate the opportunity for surprise that is possible when armies move under the cover of darkness and poor weather through terrain that other armies consider impossible.

60. Advanced Development and Flight Demonstration of the Antimateriel Incendiary Submunition (AMIS), vol. 1, Component Development, Air Force Armament Laboratory, Eglin AFB, Fla., January 1984, 3-15. Lucinao Bellero, "The New Generation of Land Mines: Requirements and Materiel for the '90s," Military Technology, July 1985, 50-59. AMIS is a wide area, direct attack munition. Released from a dispenser, the cylinder shaped AMIS deploys by parachute. A probe is used to ensure the descending AMIS detonates above the ground. The AMIS kill mechanism is multiple, self-forging fragments, which in conjunction with incendiary materiel, is capable of providing mechanical or fire kill for a variety of targets from very soft to light or medium armor. In addition, the large quantity of smaller, interstitial fragments enable AMIS to be effective against soft targets such as personnel, radar vans, and aircraft. Although AMIS is cylinder shaped for 360 degree coverage, the same self-forging fragment capability can be obtained in a shape designed for a more directed effect, as in the Claymore Mine. The use of different materiels also offers the possibility of greatly extending the already significant effective range of the self-forging fragments. The ERAM sensors were designed to detect and classify vehicles from a

significant distance so that a warhead could be fired to intercept and destroy vehicles classified as tracked.

61. For an excellent treatment of the operational level of war, see Edward N. Luttwak, "The Operational Level of War," International Security, Winter 1980-81, 61-79; Lt Col L. D. Holder, US Army, "A New Day for Operational Art," Army, March 1985, 22-32; Richard Simpkin, Race to the Swift, especially 19-53, 93-115.

62. Procedural training is the main objective of Blue Flag. However, perhaps a reversal to this tendency has begun with the development of the Warrior Preparation Center in Europe. See Lt Gen John R. Galvin, US Army, "Warrior Preparation Center: USAF/Army Hammer Out Close Cooperation," Armed Forces Journal International, August 1984, 101-4.

63. Lt Col L. D. Holder, US Army, "Training for the Operational Level," Parameters, Spring 1986, 7.

64. Air Force Manual 1-1, Basic Aerospace Doctrine of the United States Air Force, 5 January 1984, 2-14, 3-3. AFM 2-1, Tactical Air Operations--Counter Air, Close Air Support, and Air Interdiction, 2 May 1969, most of the same flaws are found in its proposed replacement, the 23 September 1985 draft AFM 2-XC, Tactical Air Operations.

65. Army Field Manual 100-5, Operations, 20 August 1982, 1-2, 1-3, 1-5, 8-6, 9-9. To show how air power and air interdiction can contribute to an offensive Army, doctrine should use 1944 operations in Italy and France as an example, rather than operations in the Civil War.

66. For a more detailed treatment of these issues, see Lt Col Price T. Bingham, US Air Force, "Battlefield Air Interdiction and the Evolution

of Doctrine," a paper presented at the 1985 Tactical Fighter Symposium, Langley AFB, Va.

67. Col Huba Wass de Czege, US Army, "How to Change an Army," Military Review, November 1984, 32-49. Although he focuses on the Army, much of what he says is applicable to the Air Force regarding problems involved in institutionalizing change and the key role education must play in such a process.

68. See, for example, Lt Col Barry D. Watts, US Air Force, The Foundation of US Air Doctrine (Maxwell AFB, Ala.: Air University Press, 1984), 110.

69. For an in-depth treatment of this subject, see Col Thomas A. Fabyanic, US Air Force (Ret), "War, Doctrine, and the Air War College," Air University Review, January-February 1986, 2-29.

70. Richard K. Betts, "Conventional Deterrence: Predictive Uncertainty and Policy Confidence," World Politics, January 1985, 164. Also, Col Ruprecht Haasler, Federal Republic of Germany Army, and Lt Col Hans Goebel, Federal Republic of Germany Army, "Uneasiness about Technological Progress in the Armed Forces," Military Review, October 1982, 62-72.

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